DALLISGRASS

TEXAS AGRICULTURAL EXPERIMENT STATION

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DIGEST

This bulletin reports some of the studies conducted with Dallisgrass and pasture mixtures containing Dallisgrass in Texas during the past 20 years. The studies reported include early observations on adaptation, establishment, yield and forage quality, response to fertilization, utilization by livestock and seed production.

Dallisgrass is a good quality forage plant that grows well in association with Bermudagrass and white clover. It is a perennial bunch grass introduced into the United States from South America. Dallisgrass is adapted to Gulf Coast and East and Central Texas areas receiving 35 inches or more annual rainfall. It grows best on clay and loam soils that are moist, but not wet, and are high in organic matter, but will grow on most soils in these areas.

Dallisgrass is difficult to establish primarily because of poor seed quality and slow germination. Satisfactory stands can be obtained in the rice belt by broadcasting seed in standing rice following the last flooding, or in rice stubble. Such plantings should be made between October 1 and November 15. Best results have been obtained in other areas of Texas by planting good quality seed on prepared seedbeds in late winter and early spring. Good results have been obtained in soils heavily infested with weeds by drilling Dallisgrass seed between oat rows in late winter, but care should be taken to eliminate the oat competition early in the spring. Seeding rates should be based on a knowledge of the quality of the seed being planted.

Forage production and quality depend largely on soil type, fertility and moisture. Yields in excess of 10,000 pounds of air-dry forage per acre with irrigation are reported. Average yields without irrigation would usually range from 2,000 to 6,000 pounds of air-dry forage per acre annually. Dallisgrass is usually not grown alone, but in association with Bermuda and one or more legumes, where it makes a significant contribution to the mixture. Dallisgrass responds to fertilization in both quantity and quality of forage. Actual fertilization practices should depend on the soil type, fertility and moisture.

Dallisgrass makes fair quality hay either after a seed crop has been harvested or before the seed mature. Care should be taken in harvesting and feeding seed hay that contains a high amount of ergot because of the danger of ergot poisoning.

Seed yields and caryopsis content of seed material of Dallisgrass usually are low. Seed quality (percentage caryopses) usually is better in the spring and early summer before daily maximum temperatures exceed 85 to 90° F. and daily relative humidities drop below 40 to 50 percent. Seed quality in July, August and early September is likely to be very low. An early spring application of nitrogen (60 pounds of nitrogen per acre) has resulted in significant increases in seed yields in June. Seed quality is not significantly influenced by the use of nitrogen. Dallisgrass seed may be harvested by direct combining or by mowing, windrowing and combining from windrow. Combine-run seed should be dried before storing.

ACKNOWLEDGMENTS

Marvin E. Riewe furnished data on pastures at the Darrington Prison Farm, R. C. Potts data on yield and chemical composition of grasses at the Brazos River Valley Laboratory and F. L. Vavra assisted in the collection of much of the forage and seed data. Results of other experimental work on Dallisgrass in Texas have been used as shown in the literature citations.

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DALLISGRASS

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DALLISGRASS, *Paspalum dilatatum* Poir., is recognized as one of the more desirable forage species in the humid parts of Texas and the Southern States. It produces good quality forage, grows well in association with Bermudagrass and white clover, and fits well into farming system rotations. Dallisgrass is a perennial, native to Northern Argentina, Uruguay and Southern Brazil. It has smooth leaves, a deep, strong root system and grows in clumps or bunches 2 to 4 feet high. Many leaves grow near the base, but few grow on the stems. The stems are weak and spreading, seldom erect unless in dense stands or supported by other grasses. It continues growth later in the fall and starts growth earlier in the spring than most warm-season grasses. Figure 1 shows the type of growth made by Dallisgrass.

Vasey (14) recorded planting of Dallisgrass in Southeast Texas as early as 1875. Other records (8) indicate that it was first introduced into the United States in the vicinity of New Orleans, Louisiana. It was given the name of Dallis for A. T. Dallis of LaGrange, Georgia, who was an enthusiastic proponent of the grass around 1900.

ADAPTATION

In the United States, Dallisgrass is adapted to practically the same area as the cotton plant, except that it does not spread west of the humid eastern portion of Texas. While it occurs on most all types of soil, it grows best on clay and loam soils that are moist, but not wet, and where organic matter is abundant. It requires a higher soil fertility than Bahia and carpetgrass.

Early work with Dallisgrass and its distribution in Texas shows the area of adaptation to be about that shown in Figure 2. Work at Angleton from 1931 to 1937 showed the superiority of Dallisgrass over native sod. This work demonstrated the ability of Dallis to grow during the summer and during warm periods in the winter. Similar work was carried on at Beaumont from 1929 to 1940 and Dallis performed satisfactorily.

Observational plantings at Nacogdoches and Lufkin from 1932 to 1939 showed Dallis to be adapted in that area.

Dallisgrass was planted at Denton in 1929-37, at Balmorhea, 1932-35, and at Beeville, 1941-42, but poor results were obtained. Difficulty was encountered in obtaining and maintaining stands in these areas, and it was concluded that Dallis was not adapted to them.

Observations and research in more recent years indicated that Dallis production is not profitable west of the 35-inch rainfall belt except along streams, ditches and in areas where extra water is received.

Dallisgrass will grow in South and Southwest Texas with irrigation, but generally does not produce as much as better adapted species (5). Comparative yields of Dallisgrass and other

CONTENTS

TABLE 1. FORAGE YIELD OF IRRIGATED PERENNIAL WARM-SEASON GRASSES IN THE WINTER GARDEN AREA, 1952-53

Species	Pounds of air-dry forage per acre		
	1952	1953	Average
Dallis	8330	10360	9340
Coastal Bermuda	13280	27790	20530
Buffel	16180	22030	19100
Blue panic	13920	23290	18600

species are shown in Table 1. Dallis does not seem to have the production potential necessary for an irrigated grass in this area. Disease and physiological problems that are not common in other areas also are encountered. Loss of stands has been encountered in experimental plots that was traced to a disease but the causal organism has not been identified. Dallisgrass also may show chlorotic effects while adjacent plots of other species remain healthy.

ESTABLISHMENT

Seed Quality

The establishment of Dallisgrass has been a problem since its introduction. Research in recent years shows that much of the difficulty in establishment can be traced to poor seed quality and improper date of planting. Owens (7) in Louisiana found that Dallis seed dropped in germination from 70 to 32 percent when stored for 12 months in the laboratory. Storage for an additional 12 months resulted in a germination of only 6 percent. Under conditions of high temperature and high humidity, loss of viability may be even more rapid. Limited experience by the author has indicated that seed stored through the summer in Central and South Texas are likely to be extremely low in viability. Such seed should be tested for germination before planting and seeding rates should be adjusted on the basis of seed quality. Seed of unknown or questionable quality should be tested just prior to planting.

Seeding and Cultural Practices

In the rice growing area of the Gulf Coast of Texas, good stands of Dallis may be obtained by broadcasting seed in the standing rice following the last flooding or in rice stubble without seedbed preparation. Such plantings should be between October 1 and November 15. Earlier seedings encounter disease problems and later seedings may be killed by frost. The Rice-Pasture Experiment Station at Beaumont harvested seed with a combine from pastures and used the seed, following cleaning, to establish pastures

Figure 1. A plot of Dallisgrass showing growth habit and seeding characteristics.

successfully (12). Broadcast seedings at the rate of 18 pounds per acre in rice by airplane in mid-October gave good results.

Volunteer stands of Dallisgrass-clover have been observed in rotation with rice at the Rice-Pasture station (13). Areas which had been in pasture 2 to 3 years were planted to rice in 1950. In the spring and summer of 1951, volunteer Dallisgrass was observed, amounting to one plant per square foot, in areas which had been flooded by drainage water from adjacent rice fields. This was an unusually dry season. These results suggest that Dallisgrass can be expected to volunteer following one rice crop in the eastern part of the Texas rice belt in seasons of average or higher rainfall, or if irrigated. Clovers have been observed to volunteer each fall and winter following a rice crop, provided the plants are allowed to mature seed in the spring before preparing for rice seeding.

The influence of degree of seedbed preparation on establishment of Dallis and Bermuda in Southeast Texas (1) is shown in Table 2. The tillage practices were light disking, heavy disking, flatbreaking and cultipacking, and no tillage. The area received a 30-60-30 fertilizer before seeding. As the intensity of tillage increased, the percentage ground cover of Dallis and Bermuda increased and native grasses decreased. This indicates that seedbed preparation, or at least placing the seed in firm contact with the soil, is necessary for good establishment.

Companion Crops and Mulches

Mulching with straw or using seed hay gives good results with grasses in general where stands are difficult to obtain. The use of straw mulch generally is too expensive to be followed in pasture establishment. Drilling grass seed in dead stubble planted specifically to provide ground cover was successful in establishing stands with some species. Studies (4) involving date of planting and the use of straw mulch, dead stubble and companion crops along with a clean seedbed for obtaining stands of Dallisgrass, are recorded in Tables 3 and 4.

The results presented in Table 3 indicate little value for straw mulch. Weed competition was a greater factor in preventing stand establishment than was surface soil moisture. Straw mulch

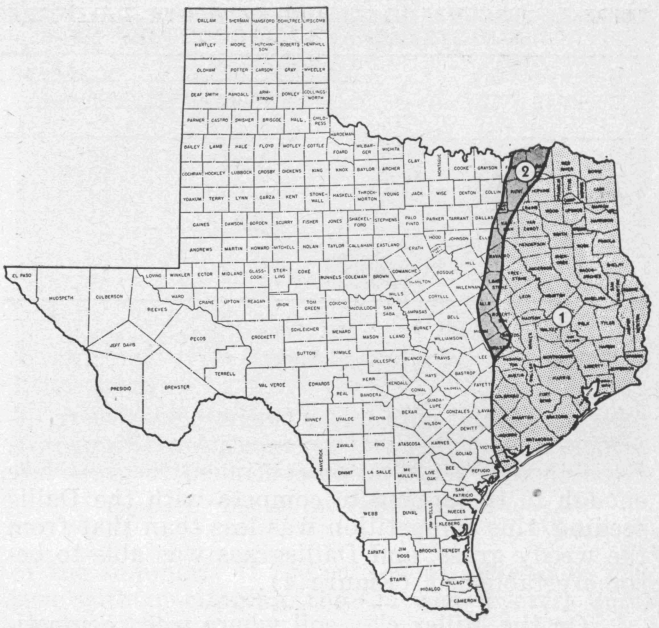

Figure 2. Area 1 is the general area of adaptation of Dallisgrass in Texas. Dallisgrass also will do well in area 2 on soils receiving extra water, such as creek bottoms.

was not effective in reducing weed competition. The results obtained differed at each location, and it is assumed that specific soil conditions and planting practices will significantly influence the procedure to be used.

Seedings were made on Lufkin fine sandy loam and Miller clay soil with a Hancock drill equipped with double disk openers and depth bands. Alternate seed boxes were used so that 20-inch rows resulted. Dallis seeding rates were adjusted to give 1.5 pounds of pure live seed per acre. Actual amounts of seed material varied from 5 to 20 pounds per acre because of variations in germination. Best results were obtained on Lufkin soil when Dallis was drilled between the 20-inch oat rows in the fall or in oats or crimson clover in early spring. Fall-planted sorghum and cowpeas made insufficient growth to be of value, and no crop remained the following spring. Results with these treatments are equivalent to spring planting on an unprepared seedbed with no crop litter present.

The Lufkin soil used for this test was heavily infested with *Brachiaria extensa*, a weedy an-

TABLE 2. EFFECTS OF TILLAGE PRACTICES ON ESTABLISHING PASTURE GRASSES ON NATIVE SOD, KIRBYVILLE, 1951

Tillage practice	Percent ground cover, December 3, 1951					
	Dallis-grass	Bermuda-grass	Carpet-grass	Native grasses	Weeds	Total vegetation
No tillage	0	0.2	0.7	18.1	3.7	22.7
Light disking	1.0	0.3	1.6	18.0	7.7	28.3
Heavy disking	3.2	14.4	0.3	7.2	2.0	27.1
Flatbreaking and cultipacking	5.5	27.6	1.6	3.7	1.8	40.2
LSD[1]	2.2	11.3	—	5.4	4.6	4.7

[1]The difference in ground cover must equal or exceed the amount shown to give odds of 19 to 1 that such difference is real and not due to chance.

TABLE 3. PERCENTAGE GROUND COVER OF DALLISGRASS SEEDED WITH VARIOUS COMPANION CROPS NEAR COLLEGE STATION AND NACOGDOCHES, 1951-52

Companion crop	College Station				Nacogdoches	
	Lufkin fine sandy loam soil		Miller clay soil		Nacogdoches clay loam	
	A[1]	B[1]	A	B	A	B
None	45	37	45	29	10	72
Straw[2]	30	23	44	48	12	50
Sorghum	38	24	45	56	28	53
Cowpeas	35	25	39	49	32	25
Dixie Wonder peas	48	23	43	28	37	20
Oats	61	62	43	36	17	32
Crimson clover	47	48	38	34	—	—

[1]A—Companion crops and Dallis seeded in the fall.
B—Companion crop fall-seeded, Dallis spring-seeded.
[2]Sawdust was used at Nacogdoches.

nual grass, and oats and crimson clover were effective in reducing weed competition (Figure 3). Even though these crops continued to grow late enough in the spring to compete with the Dallis seeding, this competition was less than that from the weedy grass, and Dallisgrass was able to become established (Figure 4).

On the Miller clay soil where weed competition was less a factor, treatment differences were relatively small. Evidently the competition created by the companion crops was about equal to that from weeds on plots having no companion crop. In 1952-53, when weed competition was small, significantly better stands were obtained in the absence of companion crops, but best results were obtained in 1953-54 with oats as a companion crop (Table 4).

The results at Nacogdoches (Table 3) indicate that best stands can be obtained in this area from spring seeding on prepared seedbeds. The plots were seeded with hand equipment and the seed could not be put into the soil on unprepared plots (Dixie wonder peas and oats). Even though weed competition was a serious problem on plots having no companion crop, the ability to place the seed in firm contact with the soil was evidently a greater factor than the weed competition. Fall planting was not effective at Nacogdoches because seedlings emerging during the winter were winter-killed.

Figure 3. An oat stubble plot (right) and a spring-prepared check plot (left) on June 9. Notice the heavy weed growth in the check plot.

Results of a date-of-seeding study at College Station are given in Table 4. These data indicate that Dallis may be seeded in this latitude almost anytime from mid-October to mid-April with fair results. In most instances, fall seedings of Dallisgrass do not emerge until later because of lack of soil moisture. Emergence has been noted in mid-winter, at which time seedlings are likely to be winter-killed. For this reason, late winter and early spring seedings are recommended.

The data in Tables 3 and 4 are given in percentage ground cover in the row. None of the values approach 100 percent. However, with the growth habit and reseeding ability of Dallisgrass, a solid ground cover is not necessary for good forage production.

FORAGE PRODUCTION

Pure Stand Yields

A number of warm-season grasses were grown in pure stands at College Station on Lufkin fine sandy loam from 1943 through 1946. Yields of three species in this test are given in Table 5. Lufkin soil is generally too drouthy and

TABLE 4. PERCENTAGE STAND OF DALLISGRASS WITH VARIOUS SEEDING DATES AND COMPANION CROPS NEAR COLLEGE STATION ON MILLER CLAY SOIL, 1953-54

Companion crop	Date of seeding			Average
	10-15-53	2-15-54	4-15-54	
None	25	20	68	38
Berseem	38	12	5	18
Oats	75	60	55	63
Average	46	31	43	

too low in fertility for Dallis to do well on it. Average annual yields of hay exceeded 4,000 pounds per acre during this test. However, yields declined each year of the test until Dallis produced only 1,900 pounds of forage per acre in 1946.

Results of a test at the Brazos River Valley Laboratory near College Station on Miller clay soil, 1946-48, are presented in Table 5. Other species not shown but which were included in this test were Common Bermuda, Ribbed paspalum, King Ranch bluestem and blue panic. Dallisgrass was among the highest yielding species the first year and also gave satisfactory results the second year. The 1948 season was too dry for most grasses to do well, and this was especially true for Dallis since it does best in a moist soil.

The performance of Dallisgrass at Prairie View (10) on Hockley fine sand is given in Table 6. The test area received a 20-40-20 fertilizer in 1951 and 100 pounds per acre of nitrogen in three applications in 1952. Dallisgrass produced only half as much forage as Coastal Bermuda in this test, but almost as much as Common Bermuda. Because of its adaptation to use in mixtures with Bermudagrass, it should be considered when summer grass mixtures are used.

Results of a test at Kirbyville (1), in which two strains of Dallisgrass were used, are given in Table 7. These strains were developed by the Louisiana Agricultural Experiment Station and Strain 430 is available commercially. Strain 430 yielded less in the spring than Coastal Bermuda, but about the same in the summer and fall. Coastal was faster starting in the spring than Strain 430. Dallisgrass has not compared as favorably with Bermuda farther north in Texas. Dallis produced 5,300 pounds of air-dry forage per acre at Mt. Pleasant in 1943 and Common and Coastal Bermuda produced 9,600 and 13,400 pounds, respectively. However, this test was on sandy land which is better adapted to Bermuda production than to Dallis.

The use of winter annual crops on Dallis-Bermuda sod in the Gulf Coast area shows some possibility (9). This practice has an advantage over winter annuals on prepared seedbed in that grazing is possible sooner after rains. Oats seeded in 10 or 20-inch rows at the Angleton station, and clipped regularly throughout the growing season, reduced the yield of Dallis-Bermuda in June, but yields were satisfactory the remainder

TABLE 5. AVERAGE ANNUAL YIELD OF WARM-SEASON GRASSES NEAR COLLEGE STATION

Species	Pounds of air-dry forage per acre	
	Lufkin fine sandy loam soil, 1943-46	Miller clay soil, 1946-48
Dallis	4700	4160
Bahia	2060	——
Rhodes	5000	——
Coastal Bermuda	——	3710
Johnson	——	5650

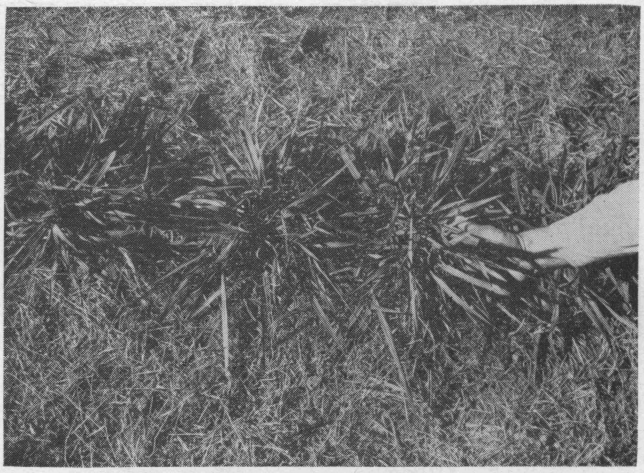

Figure 4. Dallisgrass established in rows.

of the summer. If the oats were allowed to mature without clipping, the sod was severely damaged or killed.

Response to Fertilization

Beaumont

Some early soil fertility work at Beaumont with light rates of fertilization shows that Dallisgrass responds well to fertilization. The work was done with a Dallis-carpet-white clover mixture. When no fertilizer was applied, forage production over the 6-year period, 1935-1940, averaged 1,620 pounds per acre. This yield was increased to 2,960 pounds when 32 pounds of phosphoric acid (P_2O_5) per acre were applied annually. The marked response to phosphorus was no doubt due to the presence of white clover in the mixture. There was a further increase to 3,220 pounds per acre with the addition of 16 pounds of nitrogen annually. Applications of nitrogen in such small increments are not now generally recommended for grasses. Figure 5 shows a mixture of Dallisgrass and white hop and Persian clover on the plots at Beaumont.

College Station

The response of Dallisgrass to different fertilizer treatments on Lufkin fine sandy loam soil at College Station is shown in Figure 6. Good yields were obtained in 1943 and 1944, but there was not much response to fertilization until 1946. Phosphorus increased yields the first 3 years and nitrogen with phosphorus further increased yields in 1943. The treatments were not applied an-

TABLE 6. FORAGE YIELD OF WARM-SEASON GRASSES AT PRAIRIE VIEW, 1952

Species	Pounds of air-dry forage per acre			
	June 6	July 16	Sept. 4	Total
Dallis	——	4090	1470	5560
Coastal Bermuda	4530	5120	2590	12240
Common Bermuda	2550	2470	1200	6220
King Ranch bluestem	——	1650	2690	4340

TABLE 7. FORAGE YIELD OF WARM-SEASON GRASSES AT KIRBYVILLE, 1951

Species	Pounds of air-dry forage per acre						
	May 5	June 18	July 30	Aug. 31	Sept. 29	Nov. 16	Total
Dallis B230	300	——	800	300	1100	180	2680
Dallis 430	290	——	1070	420	1660	255	3695
Coastal Bermuda	1340	260	1000	440	960	515	4515
Common Bermuda	55	——	725	230	270	405	1685

nually in this test. In 1946 when nitrogen was reapplied, the combination of nitrogen and phosphorus gave satisfactory results. Normally both nitrogen and phosphorus are needed on this soil for good plant growth. These results indicate that annual applications of nitrogen are necessary for best results. Two or more applications annually are preferred.

Brazos River Valley

Dallisgrass shows response to fertilization even on fertile soil. Yields were increased from 5,000 to over 8,000 pounds per acre in 1946 on Miller clay soil by the addition of nitrogen and phosphorus (Figure 7). Yields were more than doubled in 1947 and 1948 by the addition of nitrogen. Phosphorus alone gave very little increase over no fertilizer. In combination with nitrogen, phosphorus gave no increase over nitrogen alone. Even though the yields were more than doubled in 1948, all were extremely low because of dry weather. These results show, however, that grasses will respond to fertilization even during extended drouthy conditions.

Nacogdoches

A fertilizer factorial test was conducted at Nacogdoches in 1949-51 with a Dallis-Bermuda-common lespedeza-white clover mixture (6). Twenty-four treatments were used, including all possible combinations of 0, 30, 60 and 90 pounds of nitrogen (N), (ammonium nitrate, 33.5 percent); 0, 60 and 90 pounds of phosphoric acid, (superphosphate, 20 percent); and 0 and 60 pounds of potash (K_2O), (muriate of potash, 60 percent), per acre. These materials were disked into a well-prepared seedbed. The area was seeded broadcast in March 1949 with a mixture of 5 pounds of Common Bermudagrass, 20 pounds of Dallisgrass and 20 pounds of common lespedeza per acre. The soil was packed firmly with a cultipacker after seeding. The area was over-seeded in the fall of 1949 with 2 pounds of white clover per acre. The complete fertilizer treatment was repeated on each plot as topdressing in the late winter of 1949 and again in 1950.

Data were obtained from 11 clippings of forage—4 in 1949, 4 in 1950 and 3 in 1951. The rainfall in 1949 and 1950 was near normal, but 1951 was an extremely dry year.

Table 8 shows the benefits of using nitrogen or phosphorus, alone and in combination, on the yield of dry forage. The greatest returns in pounds of forage per acre resulted from the 90-120-60 combination—90 pounds of nitrogen, 120

Figure 5. A Dallisgrass and white, hop and Persian clover mixture at Beaumont.

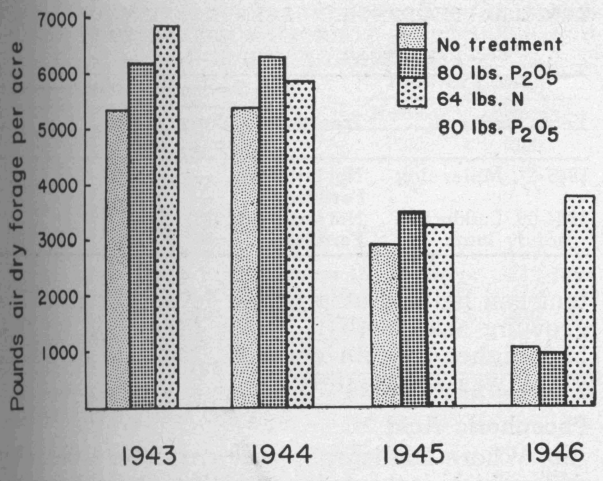

Figure 6. Response of Dallisgrass to various fertilizer treatments on Lufkin fine sandy loam, College Station. Treatments were applied in 1943 and N reapplied in 1946.

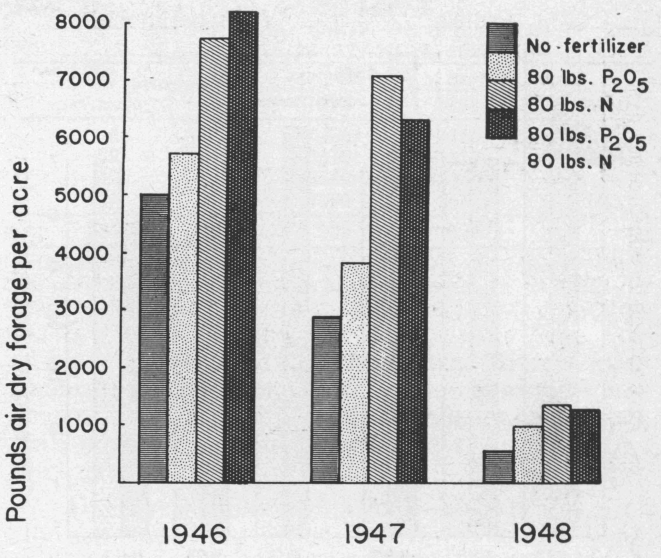

Figure 7. Forage yield of Dallisgrass as influenced by fertilizer treatments on Miller clay soil near College Station.

pounds of phosphoric acid and 60 pounds of potash per acre annually. This was not statistically higher than the yield produced by the 90-60-0 combination and, until further work is done, the 90-60-0 combination is recommended for maximum profit in this area even though other treatments produced more total forage. Continued use of such a combination probably will hasten the time when the need for potash will be critical.

The cost per ton of dry forage produced is also given in Table 8. Although 30-0-0 (30 pounds of nitrogen without phosphorus and potash) gave a fertilizer cost of only $4.20 per ton, the net return per acre for the year was only $7.70. This was due to a relatively low yield. In contrast, the 90-60-0 application gave a net return of $23.05 per acre annually even though the cost per ton of forage ($13.02) was greater. The 90-60-0 combination returned $2.31 for every dollar spent for fertilizer.

TABLE 8. SUMMARY OF FERTILIZER WORK WITH A DALLIS-BERMUDA-LEGUME MIXTURE NEAR NACOGDOCHES, 1949-51

Treatments, lbs. per acre			Average annual lbs. dry forage	Increase in lbs. of forage due to treatment	Annual cost of fertilizer[1]	Cost of fertilizer to produce a ton of dry forage over 0-0-0 treatment	Net return on fertilizer investment[2]
Nitrogen	Phosphoric acid	Potash	Per acre	Per acre	Per acre	$	Per acre
0	0	0	2180[3]				
0	0	60	2180	0	$ 3.00	0.00	—$ 3.00
0	60	0	2500	320	4.80	30.64	— .06
0	60	60	2600	420	7.80	21.47	— 1.45
0	120	0	2790	610	9.60	31.30	— .32
0	120	60	2640	460	12.60	55.59	— 5.64
30	0	0	2970	790	4.20	10.68	7.70
30	0	60	2770	590	7.20	24.77	1.73
30	60	0	3150	970	9.00	18.62	5.68
30	60	60	3180	1000	12.00	24.00	3.13
30	120	0	3230	1050	13.80	26.37	2.09
30	120	60	3650	1470	16.80	22.91	5.44
60	0	0	3540	1360	8.40	12.35	12.18
60	0	60	2540	360	11.40	64.53	— 5.95
60	60	0	4080	1900	13.20	13.94	15.55
60	60	60	3650	1470	16.20	22.09	6.04
60	120	0	3830	1650	18.00	21.86	6.96
60	120	60	3850	1670	21.00	25.20	4.27
90	0	0	3600	1420	12.60	17.75	8.88
90	0	60	4190	2010	15.60	15.55	14.81
90	60	0	4860	2680	17.40	13.02	23.15
90	60	60	4870	2690	20.40	15.15	20.35
90	120	0	4810	2630	22.20	16.90	17.59
90	120	60	5030	2850	25.20	17.70	17.92

[1]Based on using ammonium nitrate, 33 percent nitrogen; superphosphate, 20 percent P_2O_5; and muriate of potash, 60 percent K_2O, to supply the nutrients.
[2]Forage was valued at $35 per ton. Cost of baling and hauling was considered to be $4.74 per ton.
[3]Differences of 314 and 419 pounds of forage per acre required for significance at the .05 and .01 levels, respectively.

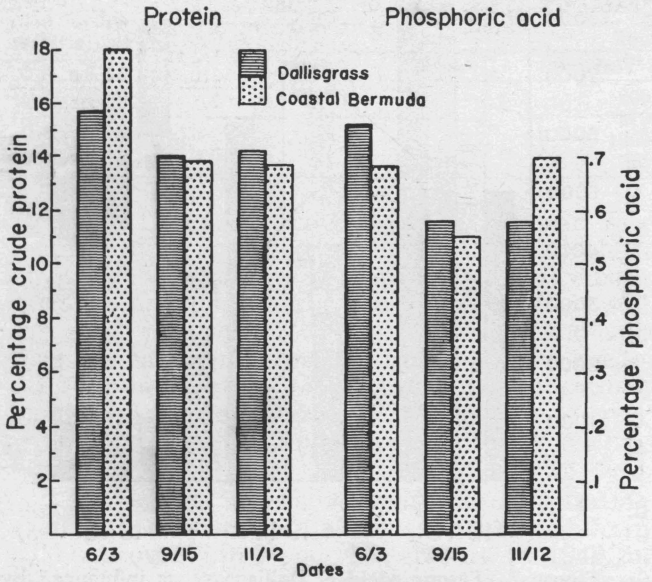

Figure 8. Protein and phosphoric acid content of irrigated warm season grasses, Winter Garden area, 1953.

Chemical Composition

The chemical composition, or nutrient value, of forage varies with many factors such as species, stage of growth, type and fertility of soil, soil moisture and season. Two important constituents of the forage are protein and phosphoric acid. Forage containing less than 6.0 percent protein and .33 percent phosphoric acid is considered deficient for cattle maintenance.

Protein

The average protein and phosphoric acid contents of Dallisgrass were reported in earlier Texas Agricultural Experiment Station publications (2,3).

Results of a test on Lufkin fine sandy loam soil near College Station (Table 9) show that the level of protein in the forage varies with the season and that proper fertilization is effective in maintaining a satisfactory protein level. In a 3-year period on upland soil, the protein content of fertilized Dallis dropped only once below 6.0 percent. The fertilizer was applied the year preceding this 3-year period and again in the final year of the period.

Results in Figure 8 show that with good moisture and fertility conditions, the protein content can be held at a higher level throughout the growing season (5). Other grasses in the test had higher protein contents, but that of Dallisgrass was satisfactory.

TABLE 9. PROTEIN CONTENT OF DALLISGRASS FORAGE AS INFLUENCED BY SEASON AND FERTILIZATION ON LUFKIN FINE SANDY LOAM SOIL, COLLEGE STATION, 1944-46

Year	Treatment[1]	Percentage crude protein			
		Early spring	Late spring	Summer	Fall
1944	Not fertilized	7.24	7.55	5.66	8.08
	Fertilized	8.25	7.65	8.43	9.31
1945	Not fertilized	10.98	6.38	7.95	6.00
	Fertilized	11.18	7.04	8.85	6.30
1946	Not fertilized	——	5.90	4.93	7.04
	Fertilized	——	6.38	5.62	7.42

[1]Fertilized with 64-80-0 in 1943 and 64-0-0 in 1946.

TABLE 10. PHOSPHORIC ACID CONTENT OF DALLISGRASS FORAGE AS INFLUENCED BY SEASON, FERTILIZATION AND SOILS

Years and soil	Treatment	Percentage phosphoric acid			
		Early spring	Late spring	Summer	Fall
1946-47, Miller clay	Not fertilized	—	.47	.48	.48
	Fertilized	—	.46	.40	.49
1944-46, Lufkin fine sandy loam	Not fertilized	.26	.22	.24	.26
	Fertilized	.36	.29	.33	.36

Phosphoric Acid

Where Dallisgrass was grown on Miller clay soil, which is high in available phosphorus, the use of fertilizer did not influence the phosphoric acid content of the forage (Table 10). However, on Lufkin fine sandy loam soil, which is low in phosphoric acid, the use of fertilizer caused a marked increase in the phosphoric acid content of the forage. Phosphoric acid content of the forage from treated plots on deficient soil was greater than that from untreated plots 4 years following the application of 80 pounds of phosphoric acid per acre.

When grown under conditions of good moisture and fertility (Figure 8), Dallisgrass contains a fair to good level of phosphoric acid (5).

UTILIZATION

Pasture

Since Dallisgrass normally is not grown in pure stands, cattle performance data from pure Dallisgrass is not available. In 1942, the Angle-

TABLE 11. PERFORMANCE OF HEIFERS ON NATIVE AND IMPROVED PASTURES AT ANGLETON, MARCH 21, 1945 TO MAY 30, 1946, 435 DAYS

Type of pasture	Native	Improved
Total days pastured	5225	5636
Number of heifers per pasture	12	12
Averages in pounds per heifer:		
Initial weight, March 21, 1945	466	468
Final weight, May 30, 1946	685	893
Gain, pounds	219	425
Feeds fed December 1945 to April 1946, pounds:		
Cottonseed meal, 43% protein	161	——
Corn chops	78	——
Prairie hay	866	623
Bonemeal	19	——
Salt	8	8
Costs per heifer, 3/21/45 to 5/30/46:		
Cost @ $13.50 cwt, 3/21/45	$62.91	$63.18
Land rent, 435 days	3.96	3.96
Cost of winter feed[1]	15.45	5.41
Total cost, no charge for pasture treatments	$83.32	$72.55
Cost per cwt. to 5/30/46, no charge for pasture treatment	$12.02	$ 8.12
Per acre cost of treatments, including mowing, to 5/30/46	——	$19.44

[1]Feed prices per ton: cottonseed cake, $58.20; corn chop, $68; prairie hay, $17.09; bonemeal, $66; salt, $22. Land rent @ $1.00 per acre per year. Each mowing, $1.00 per acre.

TABLE 12. COW AND CALF PERFORMANCE ON NATIVE AND IMPROVED PASTURE ON DARRINGTON PRISON FARM NEAR ANGLETON, 1953

Description	Type of pasture	
	Native	Improved[1]
Number of acres	700	300
Number of cows	80	80
Number of calves	50	65
Number of crossbred calves (Hereford x Brahman)	20	45
Number of Brahman calves	30	20
Average age of calves on September 15	201 days	202 days
Average weight of calves on Sept. 15	370	416
Average weight of crossbred calves	411	430
Average weight of Brahman calves	342	387
Total weight of all calves on Sept. 15	18,485	27,070

[1]Cultivated, fertilized with 0-100-0 in fall 1950 and seeded to Dallisgrass and white clover.

ton station set up a number of pastures to study methods for improving pastures on Lake Charles clay (11). The land at that time was in native bluestem pasture. Grazing results for two of these pastures from March 21, 1945 to May 30, 1946 are given in Table 11. The native pasture received no treatment. The improved pasture was plowed, disked, drained and seeded with 2.6 pounds of white clover, 2.5 pounds of common lespedeza, 6.2 pounds of Dallisgrass and 2.9 pounds of Bermudagrass per acre. One hundred pounds per acre of phosphoric acid were worked into the soil during the preparation. This pasture received no further treatment during the test.

Based on the weights taken May 30, 1946, there were 2,500 pounds more cattle weight in the improved pasture than in the native pasture. The improved pasture also could have supported more than 12 heifers during the spring and summer. The cost per pound live weight of the improved-pasture heifers to May 30, 1946, including only purchase price, land rental and supplemental feed, as shown in Table 11, was considerably lower than for the native-pasture heifers. They also carried more live weight. The cost of pasture improvement per acre, based on 1942 costs, also is shown in the table. This cost should be distributed among the cattle over several calf crops, depending on the period of effective response to treatment. These data also show that the use of Dallisgrass, Bermudagress, white clover and phosphoric acid is an effective means of improving pastures in this area.

A less comprehensive set of data from a more recent test near the Angleton station is given in Table 12. The improved pasture had very little white clover in it and was almost a pure Dallisgrass pasture. Even though the two pastures had different numbers of crossbred and Brahman calves, with differences in their growth rate, there is no doubt that the improved pasture was superior.

Hay

Dallisgrass is not used extensively for hay production, but it does make good yields of fair quality hay. Hay yields following the harvesting

TABLE 13. YIELD OF DALLISGRASS HAY FOLLOWING SPRING SEED CROP ON MILLER CLAY SOIL NEAR COLLEGE STATION, 1953-54

Pounds of nitrogen per acre	Pounds of hay per acre		
	1953	1954	Average
0	4180	1110	2640
30	5810	1510	3660
60	6560	2470	4510
120	7090	3510	5300
LSD[1]	900	820	

[1]Differences in yield must equal or exceed the amount shown to give odds of 19 to 1 that such difference is real and not due to chance.

of a spring seed crop at the Brazos River Valley Laboratory are given in Table 13. The grass was grown in rows in this test, and yields are higher than normally might be expected from stands as they usually occur in pastures.

Dallisgrass hay containing seed heads usually has some seed infected with ergot and ergot poisoning may result when seed hay is fed to cattle. However, it may be cut for hay before seed are set to avoid much of the danger from ergot. Dallisgrass with seed should be threshed or combined before baling or storing the straw to remove the ergot-infected seed. This practice would reduce the danger of ergot poisoning and also would give some seed which could be cleaned and used for seeding.

SEED PRODUCTION

Culture and Fertilization

Dallisgrass seed yields generally are low and seed quality is poor. Poor seed quality has been attributed to the presence of ergot on the inflorescence. Other species show a marked response in yields to the application of fertilizers, particularly nitrogen, and to cultural practices, such as planting in rows and cultivating. Figure 9 shows a row planting of Dallisgrass for seed production. Seed production studies were initiated in the Winter Garden area in 1950. Since this is an area of low relative humidity, it was thought that the ergot problem would be less severe and thus seed

Figure 9. A row seeding of Dallisgrass for seed production.

TABLE 14. SEED YIELD OF DALLISGRASS NEAR COLLEGE STATION ON MILLER CLAY SOIL, 1952-53

Pounds of nitrogen per acre	Pounds of seed per acre					
	1952			1953		
	Aug. 28	Nov. 14	Total	June 18	Aug. 16	Total
0	162	39	201	81	75	156
30	131	40	171	91	54	145
60	120	46	166	128	39	167
120	102	46	148	146	25	171
Average	129	43	172	111	48	159

quality better. Failure to obtain good quality seed in this area led to studies at College Station involving the relationship of climatic factors to seed set and the influence of cultural practices on seed yields and quality. These studies are reported in the sections that follow.

Seed Yields

College Station: A study involving cultivation and rates of nitrogen as they influence seed yield and quality has been conducted for 2 years near College Station. The test was planted in 40-inch rows on Miller clay soil and was irrigated twice in 1952 and none in 1953. Cultivation had no influence on seed yield or quality and is not shown in the tables. Results of the yield test are given in Table 14. In the year of establishment, there was some reduction in yield with the nitrogen treatments. Miller clay is a fertile soil and in this case needed no additional nitrogen to support the grass. In 1953, nitrogen increased yields of the first crop but decreased yields of the second crop, so that total yields were not significantly influenced by rates of nitrogen. In this case, half the nitrogen was applied in early spring and the other half was applied following the first seed harvest. These results indicate that a spring seed crop can be produced profitably with nitrogen. Almost as much seed were produced from the first harvest with 60 pounds of nitrogen (146 pounds) as were produced on the check plot at both harvests (156 pounds). Additional work is being done to determine the factors involved which cause one harvest to be increased by nitrogen and the next to be decreased.

Winter Garden: The tests in the Winter Garden area have been conducted with irrigation. Table 15 shows the results of seeding Dallis in 18 and 36-inch rows with the use of various nitrogen treatments. Good seed yields were obtained in most cases. There was no marked response to cultural practices, 18 and 36-inch rows being about equally good. Broadcast seedings were not used because of difficulties in irrigation. There was some indication that 60 pounds of nitrogen increased yield. However, nitrogen rates higher than 60 pounds produced less seed in most instances than the check plot. Results the second year of the test indicate that when the grass occupies the land for more than 1 year, greater response to nitrogen may be expected.

TABLE 15. AVERAGE SEED YIELDS OF DALLISGRASS AS INFLUENCED BY VARIOUS TREATMENTS IN THE WINTER GARDEN AREA, 1950-51[1]

Pounds of nitrogen per acre	Pounds of seed per acre		
	18-inch rows	36-inch rows	Average
0	183	181	182
60	225	199	212
120	174	158	166
180	171	144	158
240	174	168	171
Average	185	170	178

[1]Seed crops were harvested August 25 and November 7, 1950; June 12 and October 5, 1951.

TABLE 16. SEED YIELDS AND QUALITY OF DALLISGRASS AS INFLUENCED BY FERTILIZERS AND IRRIGATION IN THE WINTER GARDEN AREA, JULY 1952

Pounds per acre		Pounds of seed per acre			Percentage caryopses		
		Stage of final irrigation			Stage of final irrigation		
Nitrogen	Phosphoric acid	Boot	Bloom	Mature	Boot	Bloom	Mature
None		80	160	320	6.7	7.8	5.9
60		80	120	310	4.4	5.5	6.7
	60	90	110	330	5.9	6.1	6.1
60	60	60	130	280	6.6	3.4	6.2
Average		77	130	310	5.9	5.7	6.2

Results of a second test involving the stage of maturity at the time of final irrigation and nitrogen fertilization are given in Table 16. These results show that for best seed production in this area, Dallisgrass should have regular irrigation until the plant matures. This is particularly true on sandy soils of the type used for these tests. Seed yields again did not show any response to fertility level. However, this was the first year the land had been in grass.

Seed Quality

College Station: Only one seed crop was analyzed for caryopses in 1952 and two crops in 1953. Results of these analyses are shown in Table 17. Nitrogen had no influence on seed quality in 1952 and very little in 1953. The caryopsis content in June 1953 was lowest from the plots receiving no nitrogen, while in August of the same year, the caryopsis content was lowest from plots receiving 120 pounds per acre of nitrogen. However, these differences were not significant statistically. All treatments produced seed with satisfactory caryopsis content.

Winter Garden: Good yields of Dallisgrass seed have been produced in the Winter Garden area, but seed quality often is so low as to make the seed worthless. Results of seed analyses for caryopses from the tests at Winter Haven are given in Table 18. Caryopsis content varies from

TABLE 17. PERCENTAGE CARYOPSES OF DALLISGRASS SEED MATERIAL NEAR COLLEGE STATION, 1952-53

Pounds of nitrogen per acre	1952	1953	
	Aug. 28	June 18	Aug. 16
0	19.5	13.9	17.2
30	18.2	16.4	16.9
60	22.0	16.6	16.2
120	21.5	16.6	13.5
Average	20.3	15.9	16.0

TABLE 18. PERCENTAGE CARYOPSES OF DALLISGRASS SEED MATERIAL PRODUCED IN THE WINTER GARDEN AREA, 1950-51

Pounds of nitrogen per acre	1950		1951	
	August 9	November 7	June 12	October 5
0	6.0	11.2	22.2	1.3
60	4.5	13.0	16.7	1.0
120	5.2	11.7	20.4	1.0
180	4.2	11.1	19.1	1.1
240	3.8	8.5	20.6	.6
Average	4.7	11.1	19.8	1.0

nil to above 20 percent. Combine-run Dallis seed often are below 20 percent caryopses before the light material is removed. Average percentage caryopses in July 1952 (Table 16) was only 6 percent, which is believed to be too low to be of economical value. Work done in 1953 under climatic factors at College Station, indicates that temperature and humidity are important factors in seed set by Dallisgrass. These results suggest that temperatures at Winter Haven often may be too high and the relative humidity too low for best seed quality. Ergot was never a major factor in these studies, although some ergot was present at times.

Climatic Factors

A study was initiated in 1953 to determine the relationship of temperature and humidity, under natural conditions, to seed set of Dallisgrass near College Station. A hygrothermograph was used for keeping a continuous record of temperature and relative humidity. Individual seed heads were tagged on the day of flowering and were harvested individually as they matured. The environmental conditions existing during and immediately following the flowering period were thought to be the most important. Sixteen different periods of 3 to 6 days each were selected for study on the basis of uniformity of conditions during the period and differences between periods. Average temperature and humidity conditions for each of the 16 periods are given in Table 19 along with the average percentage seed set of Dallisgrass.

Average seed set ranged from 6.1 percent in one period in June to 48.6 percent in August. These differences were significant statistically. Maximum temperature and seed set were significantly related with a regression coefficient of −1.239. Seed set and daily minimum relative humidity also were significantly related with a regression coefficient of +0.702. A multiple regression of seed set on maximum temperature and minimum humidity was significant with R =0.758. Results of the regression analysis indicated that temperature and humidity influences accounted for a significant portion of the variability in seed set among periods.

The correlation of maximum daily temperature and minimum daily humidity was only −0.006, which is not significant. This indicates that the influences of the two environmental factors were largely independent. The data show that when an extreme in either high temperature or low humidity was reached, it overshadowed the effect of the other. The highest seed set occurred on August 28 and 29 with a temperature of 85° F. and a minimum humidity of 54 percent. On October 6 and 7, maximum temperatures was only 81° F, but minimum humidity was the limiting factor (18 percent) and seed set averaged only 18.4 percent. On July 31 and August 1, minimum humidity was favorable but maximum temperature was high (93° F.) and seed set averaged 30.6 percent. Within the limits of environmental conditions encountered, Dallisgrass seed production was favored by the lowest maximum daily temperatures and highest minimum relative humidity.

Harvesting

Harvesting may be by direct combining or mowing, windrowing and combining from the windrow. The cover picture shows a solid stand of Dallisgrass being harvested for seed with a combine. Determining the proper time for harvesting often is difficult, since flowering and maturity are uneven. Harvesting should be started when a maximum number of racemes are mature and brown in color but before shattering becomes severe. A few early-maturing spikelets will have shattered. The Rice-Pasture Experiment Station at Beaumont reported satisfactory results with combine harvesting (12). Seventy-five pounds per acre of Dallisgrass seed were harvested in October 1950 from a pasture which was grazed until 3 weeks before combining. Combine-run seed contain much green seed and should be dried before storing. This may be accomplished by spreading them in the sun or by drying them artificial with air temperatures of 110 to 120° F until the moisture content is reduced to 10 to 12 percent.

Foreign material, which should be removed from the seed for ease of planting, can be sepa-

TABLE 19. AVERAGE MAXIMUM TEMPERATURE AND MINIMUM RELATIVE HUMIDITY BY PERIODS WITH THE CORRESPONDING PERCENTAGE SEED SET, 1953

Date	Maximum temperature, °F	Minimum humidity, %	Seed set[1]
Oct. 6-7	81	18	18.4
Aug. 28-29	85	54	48.6
Sept. 4-7	86	27	30.4
Sept. 22	86	30	31.3
July 12-13	88	45	35.3
Oct. 12-13	88	24	28.2
Aug. 23-25	89	42	37.6
Sept. 16-17	90	37	31.4
Sept. 9-11	90	32	26.0
July 31-Aug. 1	93	42	30.6
July 1-3	93	42	22.9
July 27-28	95	32	43.5
June 14-17	96	35	9.1
June 25-26	98	34	9.7
Aug. 10-12	100	28	14.3
June 20-22	100	28	6.1

[1]Expressed as percentage caryopses.

rated with a regular farm-size seed cleaner. Removing the light or unfilled spikelets is a more difficult operation and special equipment is necessary for best results.

In general, the results of seed quality analyses indicate that the highest quality seed are produced in the College Station area prior to July 1. In other areas, where minimum daily humidity may not drop as low or maximum temperature go as high as in this vicinity, satisfactory seed crops may be produced and harvested later in the summer.

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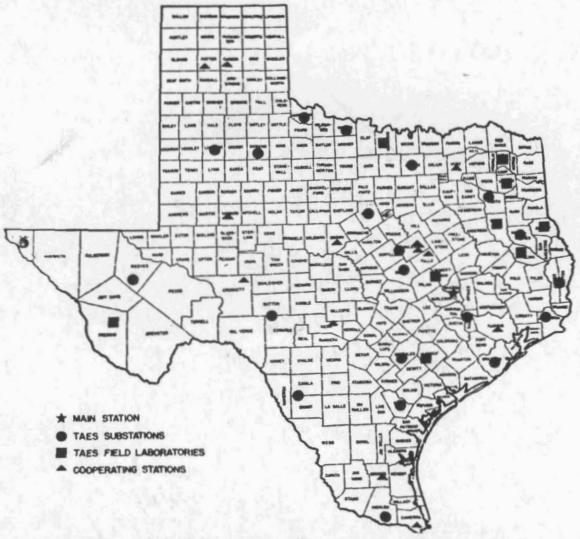

Location of field research units in Texas maintained by the Texas Agricultural Experiment Station and cooperating agencies

State-wide Research

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